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Ambivalent urban sustainability transitions: Insights from Brisbane's building sector

Sebastian Fastenrath [a, b, *], Boris Braun [b]

[a] Melbourne Sustainable Society Institute, University of Melbourne, Victoria 3010, Australia
[b] Institute of Geography, University of Cologne, 50923 Cologne, Germany

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ABSTRACT

Cities are suggested as being the key level for shifts towards more sustainable modes of production and consumption. The building sector with its significant carbon footprint plays an important role in urban climate change adaptation strategies. Using the case study of Brisbane (Australia), the paper examines the place-specific contextualisation of green building transitions by analysing the co-evolution and interplay of building practices, policy making and involved actors. Drawing on theoretical approaches of Transition Studies and Evolutionary Economic Geography, we trace back and analyse policy and economic trajectories focusing on formative and hindering processes. The paper discusses ambivalent pathways and 'regime resistance' caused by local economic and political specificities. The analysis illustrates how crucial the continual support from both policy makers and industry actors can be when economic market mechanisms do not drive sustainability transitions. Regime actors can play a powerful role as 'transition detractors' and can determine the dynamics and the scope of sustainability transitions.
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1. Introduction

Cities are increasingly understood as the key level for addressing climate change and as loci for action towards low-carbon solutions (Bulkeley et al., 2014; Hodson et al., 2017; IPCC, 2014; Loorbach et al., 2016; OECD/IEA, 2016). Scientific advisory bodies such as the German Advisory Council on Global Change (WBGU, 2016) highlight the 'transformative power' of cities as far as sustainability is concerned. Related to these understandings, sustainability transitions – socio-technical shifts from conventional towards more sustainable modes of production and consumption (Markard et al., 2012) – have been predominantly analysed and interpreted on a national level (Hodson et al., 2017). However, the role of place specificity in the sustainability context remains underdeveloped (Coenen et al., 2012; Frantzeskaki et al., 2017; Hansen and Coenen, 2015; Murphy, 2015; Nicolosi and Feola, 2016). It is widely unclear how and why sustainability transitions occur, develop and vary in different urban contexts, even though the origins are often identified on the local level (Geels, 2011).

While a growing body of literature helps in understanding 'successful' shifts, explanations for slow or distracted sustainability transitions remain largely unexamined. In other words, apart from research on model cities and 'best practice', more solid empirical research considering path dependencies, barriers and resistance is needed (de Gooyert et al., 2016; Geels, 2014; Maassen, 2012). Research is particularly lacking on 'transition resistant' city contexts for innovative practices (technological and institutional) that do not gain momentum, are delayed or distracted. We argue that a city's specific and distinctive political, economic and technological pathways and their interrelated co-evolution need to be investigated further to better understand current dynamics, drivers and barriers in urban sustainable development.

This paper contributes to closing this research gap by providing empirical insights from a case study of green building transitions in Brisbane (Australia). In contrast to global forerunner cities such as Freiburg in Germany or Vancouver in Canada, Brisbane can be seen as a 'latecomer' due to a relatively slow uptake of 'green building' practices. The building and construction sector has a significant carbon footprint and therefore plays an important role in climate change adaptation strategies (IPCC, 2014; OECD/IEA, 2013; UNEP, 2011). Surprisingly, relatively little academic literature has been published in this field. While there is increasing interest in different aspects of sustainability processes in the building sector (Cidell,

* Corresponding author. Melbourne Sustainable Society Institute, University of Melbourne, Victoria 3010, Australia.
E-mail address: sebastian.fastenrath@unimelb.edu.au (S. Fastenrath).

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2014; Faulconbridge, 2013; Gibbs and O'Neill, 2014; Smith, 2007), in-depth analyses at the city level are still lacking. This paper examines how and why green building practices develop and what barriers exist at the city level. Investigating this issue is not only relevant for further research but also for practitioners and policy makers seeking to take action on different urban sustainability areas.

The city context of Brisbane provides the opportunity to explore pathways of green building practices, in both residential and commercial sectors, with a special focus on barriers and distractions. Following a transdisciplinary approach, which combines expert knowledge from public, private and academic sectors, policy document analysis and secondary statistical data, this paper traces back Brisbane's green building pathways. We particularly focus on changed practices and the interrelated institutional, economic and political city context. More specifically, the paper examines the following research questions:

(1) What are significant changes in practice in Brisbane's building sector; when and why did changes occur or were hindered?
(2) Who are the key actors actively participating in these processes; who drives or resists sustainability transitions?
(3) How are policy making processes (e.g. regulations, incentives, guidelines) interrelated to practices in the building sector?
(4) What are significant barriers and challenges in transitioning Brisbane's building sector?

The paper is structured as follows: Section 2 covers a brief discussion of the literature on urban sustainability transitions and the conceptual approaches used for this paper. An overview and the relevance of the building sector is provided in Section 3 before the case study Brisbane and the broader context are introduced in Section 4. Section 5 outlines the methodical approaches applied in this paper. The research results are presented in Section 6 by tracing back and analysing the different phases of Brisbane's green building pathway. A final discussion, conclusions and an outlook for further research completes this paper in Section 7.

2. Urban sustainability transitions

Publications in the vibrant research field of urban sustainability transitions have started to explore cities as important arenas for grassroots movements (e.g. Wolfram, 2016), experimental niche developments, learning by doing and governance (Bulkeley et al., 2011; Nevens et al., 2013; WBGU, 2016). Even though cities are always embedded in wider political, economic and social systems at different scales, every city is an irreducible individual case (Scott and Storper, 2015). For this reason, place dependency is receiving increasing attention as an important conceptual and analytical aspect in sustainability transition research (Haarstad, 2016; Hodson et al., 2017; Nicolosi and Feola, 2016). Following critique on the interpretative flexibility (Smith et al., 2010) and the "missing or naïve conceptualizations of space" (Coenen et al., 2012) in concepts of Transition Studies (TS), the debates have resulted in a geographical and relational turn. Contributions in the recently established research field of the 'Geography of Sustainability Transitions' by Hansen and Coenen (2015) aim to add geographical and relational knowledge to established TS approaches (Bridge et al., 2013; Markard et al., 2012; Truffer and Coenen, 2012). This approach implies that places should be understood as important contexts where socio-technological change is embedded in power structures and institutions (Murphy, 2015). Cities or city regions are seedbeds of social interactions, institutions and political action. They have their own economic bases, structures of governance, planning regulations, infrastructures, cultural norms and traditions (Storper, 2013).

As Grin et al. (2010) state, socio-technical changes towards sustainable development underlie distinct normative expectations and characteristics. Sustainability transitions are not solely economic or technology driven, they must be interpreted as the result of socio-spatial dynamics (Murphy, 2015). Not only transition politics but also interactions between policy and economic structures play an important role in socio-technological change and must be further explored. Therefore, scholars are increasingly bringing together TS approaches (predominantly the 'multi-level perspective' and 'transition management') and Economic Geography (Boschma et al., 2017; Fastenrath and Braun, 2016; Gibbs and O'Neill, 2015).

Approaches from Evolutionary Economic Geography such as 'path creation' (Garud and Karnoe, 2001) and 'path dependency' (Boschma and Frenken, 2006; Martin and Sunley, 2010) are helpful in better conceptualising the dynamics of socio-technical change in light of a co-evolutionary understanding of technology and institutions. To understand and steer current socio-technological changes, 'urban sustainability transition history' must be analysed. Conceptualising and analysing pre-existing socio-economic-technological structures (Martin and Sunley, 2006) as non-linear sustainability transition pathways (Turnheim et al., 2015) helps when exploring the dynamics and interactions between practices and adaptations of innovative and established structures of so-called 'socio-technical regimes' (Geels and Schot, 2007). The geographical perspective in transition research helps in "understand[ing] the development trajectories of cities, industries, production networks, and economies" (Murphy, 2015, p. 73).

Spatial and relational perspectives are also a support when tracing back processes of resistance (de Gooyert et al., 2016; Geels, 2014) and lock-in against sustainability-oriented shifts (Maassen, 2012; de Gooyert et al., 2016; Geels, 2014). These processes, which occur when policy makers and economic actors form a "core alliance at the regime level, oriented towards maintaining the status quo" (Geels, 2014, p. 6), are under-researched. A changed focus from niche developments to the regime level is required to explore and understand barriers in sustainability transitions. Place-specific economic logics, hindering processes and 'transition detractors' need to be identified (Fastenrath and Braun, 2016). Therefore, further research needs to shed light on institutions, actors and inter-actor tension, interests and the outcomes of policies (Coutard and Rutherford, 2010; Gorissen et al., 2016). Accordingly, this paper considers place-specific institutional processes in sustainability transitions in Brisbane's building sector.

3. Green building transitions

The built environment is a significant contributor to human-related greenhouse gas emissions (IPCC, 2014), and buildings are increasingly seen as both a major cause and a solution to climate change. Transitions from conventional towards sustainable modes of building and construction are therefore playing an increasingly important role in international public debates on climate change and resource efficiency (UNEP, 2014). In countries of the 'global north', most of the energy consumed in buildings is used for space heating or cooling, followed by water heating and usage of electric appliances (OECD/IEA, 2013) (see Fig. 1). On intergovernmental levels, the significance of a more sustainable built environment and related policy support is discussed in the context of urban and regional climate change adaptation strategies (UNEP, 2014).

While there are diverse approaches and interpretations, green building is commonly understood as the practice of creating

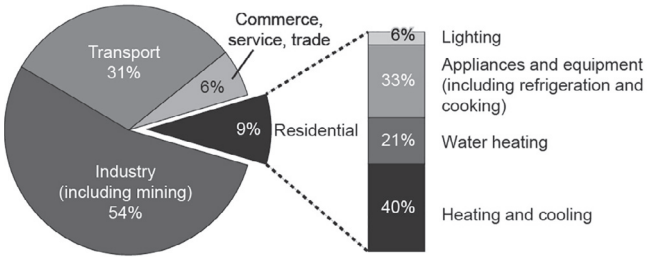

Fig. 1. Energy consumption in Australia by main sectors (left) and the residential sector (right) in 2013 (own figure, data source: AUSGov, 2015).

resource-efficient and healthier approaches for building design, construction, renovation, operation and maintenance. The adoption of 'green' architectural principles (e.g. solar, passive or low-energy design) and 'low-carbon' building technologies and materials generally reduces the energy consumption and greenhouse gas emissions in buildings (IPCC, 2007; UNEP, 2011). The IPCC (2007) recommends two main shifts to achieve greener, more resource-efficient buildings: (1) reduce heating, cooling and lighting loads (2) increase efficiency of appliances, heating and cooling equipment and ventilation. To achieve these goals, building design and urban planning principles have to be considered for different locations and climates (Bauer et al., 2013). In warmer climates, green building includes a number of aspects: building shape, orientation, internal room layout, insulation, using highly reflective building materials, shading, windows with a low solar heat gain and utilizing thermal mass (IPCC, 2007; Szokolay, 2014).

Renewable energy, such as installations of photovoltaic panels (PV) or solar hot water systems, further reduces the energy consumption in buildings. Stakeholders in the building and construction sector (architects, engineers, developers, builders, craftspersons, manufacturers) are incrementally changing routines towards 'greener' modes of production, building design, construction and operation. The drivers and the logic behind these processes of change follow different speeds and patterns with different driving and hindering actors and diverging political and industry influences. While city regions with longer histories of green building transitions can be identified, e.g. Freiburg (Germany) and Vancouver (Canada), there are also latecomers such as Luxembourg or Brisbane (Fastenrath and Braun, 2016; Preller et al., 2017). The case study of Brisbane permits a better understanding of the delays and the interrelated challenges in sustainability transition pathways over time.

4. Brisbane as a case study

Brisbane, Australia's third largest city, is the capital of Queensland and the administrative centre of the Brisbane City Council (BCC) and the Queensland State Government (QLD Gov). The city, proclaiming itself as 'Australia's New World City', is an important location for regional offices of multinational enterprises. Brisbane is more renowned for its mostly pleasant subtropical climate and lifestyles than for being a green front runner city. Its history of greening the built environment is comparably short. Brisbane's building sector has been strongly influenced and characterised by rapid population growth. During the last decades, the metropolitan area experienced growth rates of more than two percent annually. Besides brownfield developments in the inner city, new, large, master-planned communities have been initiated in Greater Brisbane and the neighbouring Local Government Areas (LGAs) of the Sunshine Coast and the Gold Coast (see Fig. 2).

In 2016, 2.3 million people lived in Greater Brisbane, accounting for almost half of Queensland's population of 4.78 million (ABS, 2016). Between 2000 and 2015, homes for more than 500,000 residents were provided (ABS, 2016). The QLD Gov's latest regional plan estimates that the population of South East Queensland will increase by 2 million people until the 2040s (QLDGov, 2016). The fast-growing urbanisation process in South East Queensland presents both a challenge and an opportunity for transitioning the building and construction sector. Practitioners and policy makers can significantly influence and determine the impacts of current and future developments in the building sector.

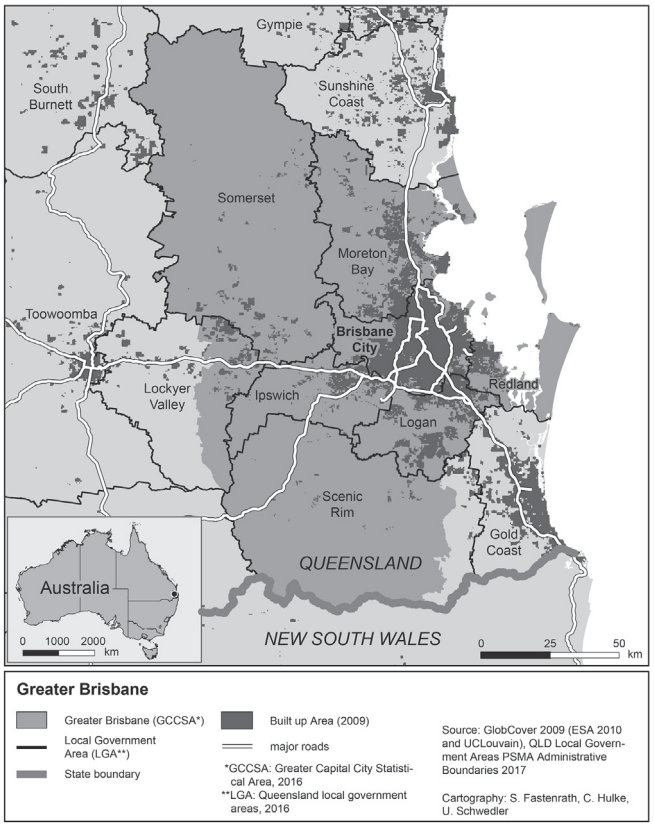

Fig. 2. Greater Brisbane, administrative and statistical boundaries.

5. Methods

The findings presented in this paper are based on a qualitative research design that includes three interlinked methodical approaches: an interactive workshop, policy document analysis and interviewing. The triangulation of empirical methods is helpful when collecting and interpreting primary data (Flick, 2004). To ensure validity of the qualitative research design, we took these multiple sources into consideration and put them together in a chain of evidence (Yin, 2014). This approach allowed us to explore different perspectives on the complex research topic. The three research steps will be described in this section.

The data collection started with an interdisciplinary kick-off workshop to develop a general understanding of key industry processes, actors and the political framework of Brisbane's building context. Ten local experts and stakeholders from public, private and academic sectors shared their insights at the workshop in March 2014. The invited participants were architects, consultants (engineering, building design, eco-tech industry), representatives of the BCC and non-governmental organisations and researchers. Using the 'World Café' workshop approach, the participants discussed four main topics in the context of transitioning Brisbane's building

sector: actors, innovative local building projects, policy framework conditions, challenges and barriers. This participatory research approach was highly valuable in developing an understanding of the multiplicity of perspectives and the drivers behind green building pathways in Brisbane (for more details about the workshop see Preller et al., 2017). The information gained through the workshop was written in a report, which was later sent to the participants for further commenting and validation.

This first research step was fundamental in directing and developing the ensuing policy document analysis and the semi-structured interviews. The workshop participants identified 34 public policies, programs and guidelines, which were mostly released by the BCC and the QLD Gov. Relevant documents, either from official websites or provided by interviewees, were reviewed. To gain an understanding of the interplay of policy-making processes and the building sector, a document analysis was conducted. Those documents helped in identifying timeframes, driving and hindering actors and shifts in political sustainability agendas.

As a third step and core element of our research design, we conducted 27 qualitative interviews in April 2014 and June–July 2015. The key goal was to gain insights from different professional perspectives. Interviewees were identified through snowballing (Clifford et al., 2016); most of the interview respondents were top-decision makers in the administration or in Brisbane's building and construction industry. The semi-structured interview approach (Flick, 2014) helped us to gain in-depth expert and practitioner knowledge. Long-term developments, vested interests, decision making processes, the role of policy making and barriers were identified by interviewing a wide range of stakeholders affiliated to public, private and academic sectors. To ensure anonymity in this paper, the interviewee's names have been given codes (see Table 1).

The average interview time was about an hour; the total recording time of all interviews was 29 h and 49 min. All interviews were audio recorded, transcribed, and exported to MAXQDA, a software for computer-assisted data analysis that helps to structure and code large interview data sources. A qualitative content analysis was used for evaluating and interpreting the interview data (Mayring, 2014; Schreier, 2014). While the method does not generate statistically representative data, researchers have the opportunity to explore complex issues that are hard to quantify, such as vested interests, strategies and informal interactions between stakeholders. The transcribed interview data was manually coded, sub-coded and then categorised (Saldana, 2016) in several rounds by focusing on the following main research topics: processes, barriers and challenges, temporal and spatial aspects, policies, actors and green building aspects.

Bringing together the three methodological perspectives was highly valuable in reconstructing Brisbane's green building pathway and in evaluating challenges and overviewing the complex interplay of place-specific processes at different times.

6. Results

Based on the primary data gained through expert and stakeholder knowledge and also on the secondary research obtained via policy documents/reports, literature review and statistics, this section describes and explains Brisbane's green building transitions in four phases. A closer look at current challenges and barriers in the residential building sector is provided at the end of this section.

6.1. Early experimental phase (1960s-1980s)

The starting point and first phase of Brisbane's green building pathway can be traced back to the 1960s. At that time, Brisbane was an important location for knowledge generation and experimentation in the fields of solar energy and solar building design (BR-Con1, BR-Pa2, BR- BR-Prac3, Prac5, BR-Re1). Research and experimental projects at the University of Queensland (UQ) were internationally recognised. UQ researchers, many of them members of the international 'Association for Applied Solar Energy' and later 'International Solar Energy Society' (ISES), worked on solar building designs (Baverstock and Gaynor, 2010). A frequently mentioned researcher in solar energy and building design was Steven Szokolay, whose contributions have been published internationally (Szokolay, 1975). An interviewed expert and decision maker in Brisbane's development industry highlighted his pioneer role:

> "[…] he was a big promoter of solar back in the 1970s […] but he was just 30 years ahead of his time. If he would have been around 20 years later, he might have been a huge impact on Brisbane." (BR-Prac5).

The locally gained expert knowledge about green and solar building principles did not form into a green building grassroots movement in Brisbane at that time. The actors, mostly researchers, were not able to influence the wider societal and political sphere or the mainstream building and construction industry in Brisbane. Therefore, this early initial green building path formation can be interpreted as dead-end path. Until today, influential bottom-up structures with driving actors from research and civil society cannot be identified in the city.

6.2. Policy path creation and local window of opportunity (1990s)

After the first phase, green building became more discussed in the 1990s. Policy-driven initiatives were shaped to support changes towards sustainability in the building and construction sector. As interviewees explained, energy efficiency, ecology and sustainability did not play a big role in planning policies until the 1980s (e.g. BR-Con2). A BCC planner described the inadequate role of sustainability in city planning policies: *"Before the early 1990s the word 'environment' did not exist in Queensland [planning] statutes"*

Table 1
Overview of interviews.

Stakeholder group	Description	Interviewee-code	Number of interviews
Practitioners	Architects, engineers, planners, cost managers, general managers, craftspersons, product manufacturers	BR-Prac (1–7)	7
Lobby group	Officials of property and building industry organisations	BR-Lob (1–5)	5
Administration	Employees BCC, QLD Gov (former and current from different authorities)	BR-Adm (1–6)	6
Consultancy	Managers of small, medium and large enterprises	BR-Con (1–5)	5
Professional association	Representatives of building, architecture, engineering professionals	BR-Pa (1–2)	2
Research	Universities	BR-Re (1–2)	2
			27

(BR-Adm3). The key policy initiative that changed this situation was the 'National strategy for ecological sustainable development', released in 1992 by the Council of Australian Governments (COAG), on the federal level. Workshop participants and interviewees emphasised the initiative as the beginning of green building policies in Australia. A stakeholder related to Brisbane's property development industry shed light on these first important policy initiatives:

> "Sustainability, or as it was called ecologically sustainable development, was a sort of the forefront of thinking around public policy in urban planning in Australia and there was sort of a parallel process. I guess, through the 1990s there was greater interest in green building." (BR-Prac5).

As our policy document analysis showed, a number of initiatives were started to increase energy efficiency of residential and commercial buildings and domestic appliances in the 1990s. A key political objective was to influence householders to reduce the use of energy and to change to energy sources with lower greenhouse gas emissions (COAG, 1992). As a consequence, the development and implementation of a national House Energy Rating Scheme was targeted. Furthermore, the Building Code Australia (BCA) (since 2011, National Construction Code (NCC)), which sets provisions for the minimum design and construction of buildings throughout Australia, was renewed and adopted by the state governments in 1993 and 1996. Concurrently, sustainability policies at the state level were introduced: the Queensland Environmental Protection Act in 1994 and the Integrated Planning Act in 1997. Eventually, the window of opportunity opened for local policy action. These policy initiatives encouraged the local councils to implement sustainability initiatives. As a result, BCC officers in the former 'sustainability unit' conceptualised a building rating tool, a city own House Code and an Energy Efficiency Code as part of the 'Brisbane City Plan 2000' (BR-Adm3, BR-Con2, BR-Prac2).

6.3. Ambivalent sustainability transitions (2000s)

The innovative ideas of building codes as part of the city plan were accepted by the BCC but not approved by the higher-level planning authorities of the QLD Gov. An interviewee who participated in the negotiations underlined the critical role of the state government but also of lobby groups linked to building and property industry:

> "The Brisbane City Council wanted to push things but then realised that the state government was going to block it. Stakeholders, like UDIA [Urban Development Institute of Australia], Master Builders and HIA [Housing Industry Association], particularly HIA, didn't want the Brisbane City Council to put in place something like that. They didn't want their members to face another restriction." (BR-Con2).

Numerous interviewees and workshop participants highlighted these powerful lobby organisations and also the state government as veto actors in Brisbane's building and construction context. However, Brisbane's city administration continued to be a strong supporter of transitioning the building sector. Ambitious sustainability goals were driven under Labor Party lord mayors and also the Liberal Party Lord Mayor, Campbell Newman (2004–2008), who had to govern with a labor-dominated cabinet during his first four years in office. New approaches in urban planning (smaller lots, performance based planning concepts) and support for usage of renewable energies and water efficiency were introduced. Also, other City Councils in South East Queensland started to support green building actively by providing guidelines and bringing together different stakeholders. A number of smaller demonstration projects in the residential sector were developed. Interviewees agreed that key industry actors, particularly big property development companies, began to discuss green building *"as part of their philosophy"* (BR-Prac6). Nevertheless, the mainstreaming of greener building practices did not occur for either greener homes or commercial buildings.

This status quo changed significantly in the mid-2000s, as stakeholders and experts with different backgrounds agree (e.g. BR-Adm1, BR-Prac1, BR-Prac6, BR-Re1). The BCC and the QLD Gov administration provided guidelines and economic incentives for greener buildings, especially in the commercial sector. The BCC's report 'Our shared vision - Living in Brisbane 2026' (BCC, 2006) explicitly highlights the crucial role of a "well-designed and responsive built environment". The 'Plan for Action on Climate Change and Energy 2007' (BCC, 2007a), underlined the ambitious goals in addressing climate change at that time. Key objectives were the reduction of greenhouse gas emissions by 50 percent and a carbon neutral City Council by 2026. Through implementing a 'sustainable built environment policy' for its own and leased buildings, the BCC demonstrated leadership. The document states that the design and construction of the office buildings should provide vast quantities of materials and increased energy efficiency (BCC, 2007b). Furthermore, the BCC supported investors by providing economic incentives and reduced infrastructure charges (BR-Adm3, BR-Pa1).

A 'green building boom' in the commercial building sector occurred in Brisbane in the years following the release of the document (BR-Adm1, BR-Adm5, BR-Prac2). While the influence of BCC's policy support on this development is hard to measure and debated by many experts, they widely agree that the key driver was the Australian Green Building Council (GBCA) and its 'Green Star' certification. The certification tool is seen an important catalyst for new pathways in Australia's building and construction sector (BR-Lob3, BR-Prac3, BR-Prac4, BR-Prac5, BR-Prac6). One of the stakeholders highlighted the special role of the GBCA as follows:

> "A lot of the activities have been driven through the GBCA, particularly in the commercial building sector. I think that is a really important piece of the puzzle in terms of how the industry decided to respond to the challenge in sustainability and climate, because effectively that body set up to be the industry's self-regulator." (BR-Lob3).

To validate the interview statements about the 'green office building boom' and the development of 'GreenStar' certifications in Brisbane, we evaluated secondary data provided by the GBCA project directory website.[1] The data provide details about the type of certifications and about locational and temporal aspects of the certified projects. According to the GBCA point category, projects are certified as four ('Best Practice'), five ('Australian Excellence') or six ('World Leadership') 'GreenStar' point. Our analysis of the place and time of certified projects confirmed the experts' and stakeholders' statements. After a slow start during the first years, a strong uptake of certified green building projects occurred in 2008 and 2009 (see Fig. 3). Since then, the total number of certifications has continually increased.

The political influence in the uptake of greener office buildings is debated, with experts and stakeholders claiming that the development was based on property market mechanisms mainly

[1] http://www.gbca.org.au/project-directory.asp.

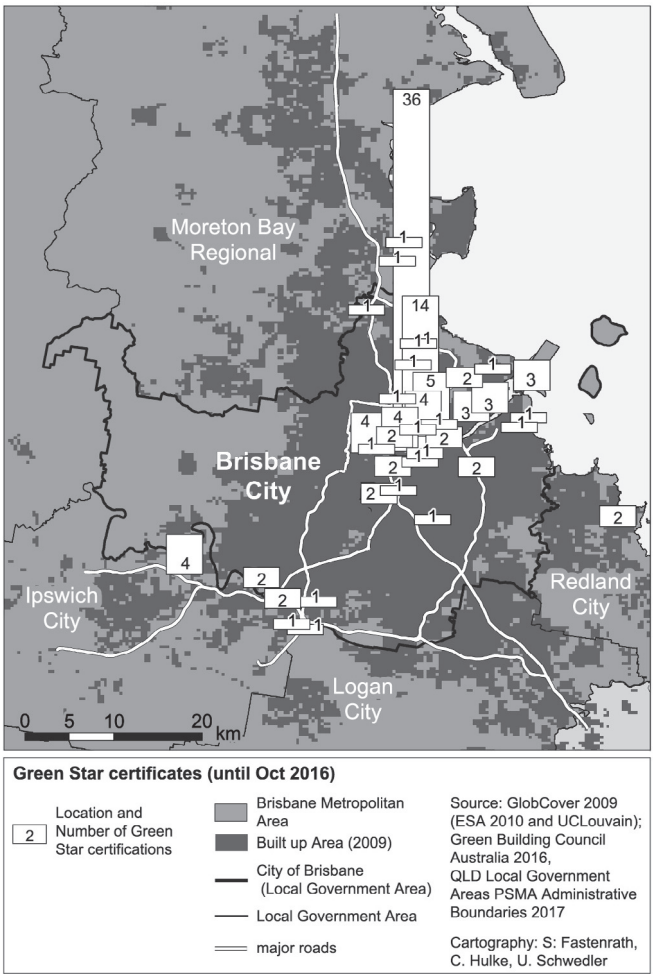
Moreton Bay Regional
Brisbane City
Ipswich City
Redland City
Logan City
0 5 10 20 km
Green Star certificates (until Oct 2016)
Location and Number of Green Star certifications
Brisbane Metropolitan Area
Built up Area (2009)
City of Brisbane (Local Government Area)
Local Government Area
major roads
Source: GlobCover 2009 (ESA 2010 and UCLouvain); Green Building Council Australia 2016, QLD Local Government Areas PSMA Administrative Boundaries 2017
Cartography: S: Fastenrath, C. Hulke, U. Schwedler

Fig. 3. Green Star certificates (4, 5 and 6 stars) in the City of Brisbane 2005–2015. (Own figure, data source: GBCA, 2016).

driven by industry actors. The adoption of 'GreenStar' certification coincided with the industry support for greener buildings by the 'Property Council of Australia' (PCA), a strong lobby group of the property industry. PCA's property ratings, which are important for the value and the leasing of office buildings, were linked to the 'GreenStar' rating tools (BR-Lob2, BR-Lob3 BR-Prac1). Interviewees highlighted the PCA 'sustainability parameters', which were added to the 'Guide to Office Building Quality' in 2006 and further improved in 2011 (BR-Lob3). The guide was used to classify office space into grades – from Premium to A, B, C or D Grade. As a result, 'GreenStar' ratings became an important benchmark for new 'Premium Grade' buildings in the CBDs and inner city suburbs (PCA, 2006). As stakeholders and experts explained, 'Premium' buildings are expected to bring reduced vacancies and a higher return on investment. Green office buildings were also becoming more prestigious and were commonly utilised as central marketing tools to increase the building and rental values (BR-Lob3). Long-term thinking of large institutional investors and of developers are seen as important influencing factors in transitioning the commercial building sector since the mid-2000s.

The results of our analysis of the locations of 'GreenStar' certifications in Brisbane support the assumption of an interrelation between 'GreenStar' and PCA's ratings. Most of the certified projects are located in Brisbane's Central Business District and surrounding inner city districts, the preferred office locations for Premium and A-grade buildings (see Fig. 4).

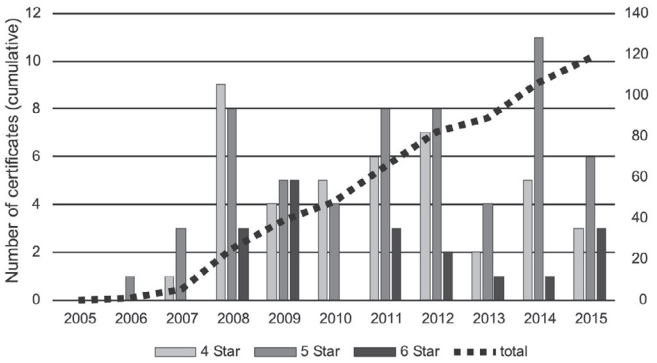

Fig. 4. Locations of Green Star certified projects in Brisbane.

Experts and stakeholders agree that the support from both private and public sectors for green building (commercial and residential) lost momentum at the end of the 2000s. Two causes could be identified for this turn. First, the global financial crisis (GFC) of 2007–2009, which led to decreasing investments in building and construction in the following years. Second, the BCC elections in 2008, when Campbell Newman was re-elected as Lord Major and the Liberal Party held a majority position in the council. The strong economic focus of the party's policy agenda was widely seen as a major barrier for continuing the green building pathway in Brisbane.

6.4. Path disruptions through regime resistance (2010s)

The conflicts in the city's agenda setting between economic and sustainability actions turned out to be more critical when Brisbane's Lord Mayor became Queensland's Premier Minister by forming a majority government of the Liberal National Party in 2012. As a result, the policy objectives shifted to an almost exclusively economic focus. When the QLD Gov and the BCC stopped a number of sustainability programs and related working groups, the green building pathway was disrupted. By using the argument of saving costs and tax payers money, programs such as the 'Climate Smart Home Service' were discontinued as part of the government's plan "to get this state back on track" (QLDGov, 2012). This program was originally conceptualised as a service for homeowners to improve their energy and water efficiency through consultation of qualified tradespersons. Concurrently, the QLD Gov's 'Office of Clean Energy' was closed, an office that coordinated programs in the field of renewable energy and energy efficiency. The requirements for new homes to include rainwater tanks and energy efficient hot water systems were scrapped (QLDGov, 2013). Furthermore, the leadership role in greening government buildings was abolished. The goal of greening own or rented buildings and the application of 'GreenStar' certifications were widely neglected both by the state government administration under the Liberal National Party and also by the BCC. As a BCC employee explained, the guidelines for the city's buildings where softened at that time:

> "We should apply for best practice. […] It is not written in that policy 'you must' or 'you have to' apply to certain GreenStar standards or NABERS [National Australian Built Environment Rating System]. What is best practice? It is very open, vague, non-committal." (BR-Adm6)

A number of experts, stakeholders, and also GBCA officials review these policy distractions at that time as critical (GBCA,

2015). However, despite the lack of political support, the commercial building sector is continually changing towards more sustainable modes. In contrast, the residential sector lags behind. Key stakeholders explained that the demand for sustainable homes remains on a low level, particularly in new master-planned communities.

6.5. Challenges and barriers in the residential building sector

In contrast to the distinct 'greening' processes in the office building sector, homes in Brisbane are still not substantially sustainable. New master-planned communities are widely seen as an important transition field. These areas, comprising homes for often more than 5000 new residents, offer the opportunity to establish more sustainable building principles and infrastructures from scratch. However, the interviews with stakeholders shed light on the complexity and the challenges in transitioning the residential sector in Brisbane. These insights provided details about the process chain from planning processes to new buildings in master-planned communities (see Fig. 5). By exploring responsible stakeholders, key barriers, and proposed changes at different stages of the process chain, we identified systemic and institutional path dependencies that make significant changes towards greener homes difficult.

We identified three major stakeholder groups that could potentially influence changes at different stages of the process chain: Policy makers (politicians and different public authorities), building and property industry actors (developers, builders, tradespersons) and home buyers. At the first and second stage, property developers and public authorities could enable transition processes during the planning stages and the subdivision of land. These most powerful actors are able to define the orientation of lots and the utilisation of innovative infrastructure. However, as a representative of a property developer explained, the developer's influence on the building design is usually limited:

> "[…] we don't necessarily deliver the built form outcome. Our business is based on the land, selling land basically. So other people come along and then build buildings on that, whether they are consumers, builders, small developers and so forth." (BR-Prac5)

While the builders, often small or medium-sized enterprises, generally decide about the building designs, features and materials, the home buyers decide about design variations that are offered in the builder's portfolio. The demand for green homes is continually low. A representative of a builder's lobby group made clear that particularly smaller companies are not willing to face early mover risks and adopt green building solutions without any cost-advantage (BR-Lob5). Affordability and the additional costs for home buyers were often reviewed as a great barrier for shifts in this sector (e.g. BR-Lob2, BR-Lob4, BR-Lob5, BR-Prac1, BR-Prac5).

In light of all stakeholder perspectives and interests in the residential building sector, the situation must be interpreted as a dilemma. Even though experts and stakeholders widely agree that the residential building sector is lagging behind and sustainability transitions are required, both policy makers and industry actors resist innovative forms of building regulation and planning approaches. The situation can be understood as an industry-policy lock-in: both sides identified the other side as the one responsible for driving sustainability forward. The debates about transitioning the residential building sector are dominated by the discussion on whether the sector needs to be driven by a regulatory push or by industry-driven demonstration projects.

One group of interviewees argued that, to push the industry actors to change their practices, resource efficiency and solar building design need to be more strictly regulated (e.g. BR-Lob2). The National Construction Code (NCC), 'Section J' (mandatory component of the NCC) and the Nationwide House Energy Rating Scheme, which set minimal energy-efficiency requirements for new homes, are seen as critical in coping with subtropical building design (BR-Adm6, BR-Prac1, BR-Prac3, BR-Prac6, BR-Lob2). Other interviewees argued that changes need to be driven by market mechanisms and demonstration projects. The GBCA's rating scheme for precincts, neighbourhoods and communities, released in 2016, raised many experts' and stakeholders' expectations. Hence, the GBCA may play a driving role as a transition agent again. Nevertheless, a majority of stakeholders assumed that significant changes in the residential building sector need to be achieved through a combination of policy regulation, the support of different industry actors and increased awareness of home buyers (e.g. BR-Con1, BR-Lob2).

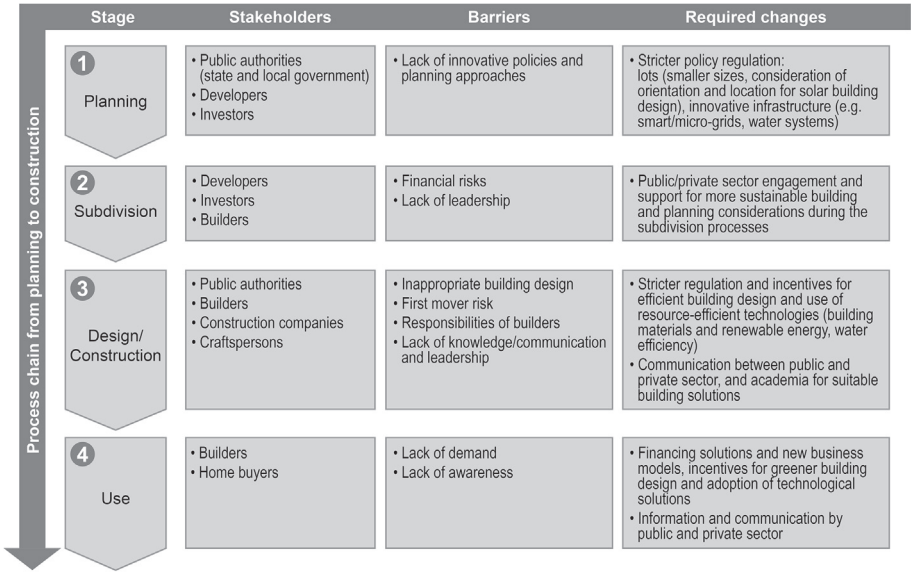
Process chain from planning to construction
Stage
Stakeholders
Barriers
Required changes
1 Planning
• Public authorities (state and local government)
• Developers
• Investors
• Lack of innovative policies and planning approaches
• Stricter policy regulation: lots (smaller sizes, consideration of orientation and location for solar building design), innovative infrastructure (e.g. smart/micro-grids, water systems)
2 Subdivision
• Developers
• Investors
• Builders
• Financial risks
• Lack of leadership
• Public/private sector engagement and support for more sustainable building and planning considerations during the subdivision processes
3 Design/ Construction
• Public authorities
• Builders
• Construction companies
• Craftspersons
• Inappropriate building design
• First mover risk
• Responsibilities of builders
• Lack of knowledge/communication and leadership
• Stricter regulation and incentives for efficient building design and use of resource-efficient technologies (building materials and renewable energy, water efficiency)
• Communication between public and private sector, and academia for suitable building solutions
4 Use
• Builders
• Home buyers
• Lack of demand
• Lack of awareness
• Financing solutions and new business models, incentives for greener building design and adoption of technological solutions
• Information and communication by public and private sector

Fig. 5. Process chain of residential buildings in master-planned communities (Own figure, slightly adapted from UNEP, 2014; based on expert and stakeholder interviews).

7. Discussion and conclusions

Drawing on the vibrant debates on urban sustainability transitions (Frantzeskaki et al., 2017; Hodson et al., 2017), this paper sheds light on the building sector with a special focus on detractions and challenges. While there is a growing body of literature on successful urban transitions, the case of Brisbane provides findings on a contrasting example. The analysis offers insights into ambivalent 'sustainability transition pathways' (Turnheim et al., 2015) and processes of 'regime resistance' (Geels, 2014). Based on expert and stakeholder knowledge and policy document analysis, the paper exemplifies the importance of considering place-time specificity for a deeper understanding of urban transition processes.

By tracing back Brisbane's green building trajectories, the paper provides in-depth insights into co-evolutionary dynamics in building practices, involved actors and interrelations within the institutional, economic and socio-political city context. The case study demonstrates how complex and distracted urban transition dynamics can be and how they vary at different times. We identified four transition phases with diverging processes, drivers and distractors.

First, Brisbane's green building pathway started early with university research and experimental projects on solar building design and energy efficiency in the 1960s and 1970s. Even though the innovative research was globally recognised in academia, the knowledge gained did not result in a broad uptake of innovative practices in the local building and construction industry. During this first phase, green building remained a niche phenomenon in both the residential and commercial building sectors. The reason can be found in the lack of societal driven bottom-up initiatives and the lack of driving 'transition agents' (Fastenrath and Braun, 2016). These missing structures might partly be a result of a lack of demonstration projects and 'learning by doing' in the first transition phase. The lack of persuasiveness and power of early adopters and innovators must be interpreted as an important piece of the puzzle in explaining current challenges in transitioning Brisbane's building sector.

Second, policy-driven top-down approaches appeared comparably late. First initiatives were developed during the 1990s, when climate change adaptation strategies, energy efficiency, and the role of the building sector became more discussed at different policy levels. New planning approaches, building guidelines and basic regulations came into being, and also the building and construction industry started to support sustainable practices by initiating demonstration projects in this second phase.

Third, green building practices and policies became a public issue during the 2000s. The BCC and also the QLD Gov demonstrated strong leadership by supporting green commercial and residential building projects. Ambivalent sustainability transition pathways evolved in the mid-2000s. While dynamics in the residential sector stagnated, a green office building boom occurred when a number of certified building projects were developed in Brisbane's Central Business District. While the effect of policy support is debated, the changes were certainly affected by property market mechanisms and industry actors focusing on long-term investments. The Green Building Council Australia played a crucial role as a 'transition agent' with its 'GreenStar' office building rating schemes.

The fourth phase is characterised by government changes from a Labor Party to a Liberal-National coalition at the local and later at the state government level. The anti-sustainability policy agenda and powerful lobby work by the building and property industry organisations must be interpreted as 'regime resistance' (Geels, 2014). They evoked disruptive policy trajectories and reinforced the low transition dynamics in the residential building sector. This contribution clearly evaluated processes of 'policy resistance' (de Gooyert et al., 2016) – the discontinuity and even pushing back of policies to initial settings – especially in the residential building sector.

The findings presented in this paper have a number of implications for further research but also provide practical insights for policy makers. Furthermore, our analysis demonstrates the importance of evaluating the heterogeneous interests and perspectives of stakeholders in the sustainability contexts. Moreover, the paper has identified driving 'transition agents' and 'transition detractors', shifts in building practices and interactions with policy and industry spheres. These findings should enable policy makers to consider specific urban conditions and the historic contexts to 'custom-tailor' sustainability actions and to create new pathways of governance. All stakeholders need to play an active role in identifying solutions towards transitioning the building sector. The applied transdisciplinary workshop concept, as part of our empirical research concepts, was highly valuable in bringing stakeholders and experts together and in generating local knowledge and ideas interactively (Preller et al., 2017). The limitation of this work derives from the lack of comparable case studies focusing on the challenges and disruptions in sustainability transitions in the building sector. Particularly a comparative study including other large Australian capital cities such as Adelaide, Melbourne, Perth or Sydney would be helpful in identifying patterns and differences of green building transitions.

Place dependency must receive more attention as a conceptual and analytical aspect in transition research (Haarstad, 2016; Hodson et al., 2017; Nicolosi and Feola, 2016). Numerous opportunities exist for future research in the field of 'Geographies of Sustainability Transitions' (Hansen and Coenen, 2015) that would help in analysing socio-technical changes in different urban contexts and in other transition areas such as energy, transport, manufacturing or food production. To better understand technological transformations and its social, institutional and economic drivers and implications, there is a need for further in-depth analysis of urban contexts.

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